Claims

[c1] 1. Apparatus (10) for locating the leading edge (E) of an object (A) comprising:
a first light source (S1) illuminating a portion of the object including its leading edge;
a first imaging means (M1) obtaining an image of the portion of the object illuminated by the first light source;
a second light source (S2) spaced apart from the first light source and also illuminating a portion of the object including its leading edge;
a second imaging means (M2) spaced apart from the first imaging means and obtaining an image of a portion of the object including its leading edge; and,
processing means (P) processing the respective images obtained by the first and second imaging means to reconstruct the leading edge of the object and establish its location.

[c2] 2. The apparatus of claim 1 wherein the position of the first light source (S1) and the second imaging means (M2) are co-located in space so to be coincident with each other as is the position of the second light source (S2) and the first imaging means (M1), thereby for the processing means (P) to utilize similarities in illumination of the object by the respective light sources and regions of mutual illumination and observation of the object to reconstruct the leading edge (E) of the object (A).

[c3] 3. The apparatus of claim 2 in which co-location of the first light source (S1) and the second imaging means (M2) and co-location of the second light source (S2) and the first imaging means (M1) provides corresponding angles of incidence and reflection in light transmitted by the respective light sources and received by their associated imaging means, and substantially identical regions of mutual illumination and observation, thereby to eliminate bias and minimize reconstruction errors by the processing means.

[c4] 4. The apparatus of claim 1 in which the first and second imaging means (M1,M2) each comprise cameras operating in the visible portion of the light spectrum.

[c5] 5. Apparatus (10) for determining the leading edge (E) of an object (A)

comprising:

a first light source (S1) illuminating a portion of the object including its leading edge;

a first imaging means (M1) for obtaining an image of the portion of the object illuminated by the first light source;

a second light source (S2) spaced apart from the first light source and also illuminating a portion of the object including its leading edge, the second light source and the first imaging means being co-located in space coincident with each other;

a second imaging means (M2) spaced apart from the first imaging means for obtaining an image of a portion of the object including its leading edge, the first light source and second imaging means also being co-located in space coincident with each other; and,

processing means (P) processing the respective images obtained from the first and second imaging means to reconstruct the leading edge of the object, the processing means utilizing similarities in illumination of the object by the respective light sources and occlusion boundaries of the respective illuminated portions of the object to reconstruct the leading edge, co-location of the first light source and the second imaging means and co-location of the second light source and the first imaging means producing corresponding angles of incidence and reflection in light transmitted by the respective light sources and received by their associated imaging means, and substantially identical regions of mutual illumination and observation, thereby to eliminate bias and minimize errors by the processing means in reconstructing the leading edge of the object.

[c6] 6. The apparatus of claim 5 in which the first and second imaging means (M1,M2) are cameras operating in the visible portion of the light spectrum.

[c7] 7. A method of locating the leading edge (E) of an object (A) comprising:

separately illuminating the object with a first light source (S1) and a second light source (S2), the two light sources being spaced apart from each other, and the respective light sources illuminating respective portions of the object with each illuminated portion including the leading edge of the object;

obtaining an image of the portion of the object illuminated by the first light

source with a first imaging means (M1), and obtaining an image of the portion of the object illuminated by the second light source with a second imaging means (M2); and,
processing the respective images to locate the leading edge of the object.

[c8] 8. The method of claim 7 in which processing the respective images to locate the leading edge of the object includes utilizing similarities in illumination of the object by the respective light sources, and occlusion boundaries of the respective illuminated portions of the object.

[c9] 9. The method of claim 8 in which the first light source (S1) and the second imaging means (M2) are co-located in space so to be coincident with each other, and in which the second light source (S2) and the first imaging means (M1) are also co-located in space so to be coincident with each other, co-location of the first light source and the second imaging means and co-location of the second light source and the first imaging means producing corresponding angles of incidence and reflection in light transmitted by the respective light sources and received by their associated imaging means, and substantially identical regions of mutual illumination and observation, thereby to eliminate bias and minimize errors in the processing of the images of the object and the reconstruction of the leading edge of the object.

[c10] 10. The method of claim 7 in which the respective imaging means (M1,M2) comprise cameras operating in the visible portion of the light spectrum.

[c11] 11. A method of locating the leading edge (E) of an object (A) comprising:
separately illuminating the object with a first light source (S1) and a second light source (S2), the two light sources being spaced apart from each other, and the respective light sources illuminating respective portions of the object with each illuminated portion including the leading edge of the object;
obtaining an image of the portion of the object illuminated by the first light source with a first imaging means (M1), and obtaining an image of the portion of the object illuminated by the second light source with a second imaging means (M2);
co-locating the first light source and the second imaging means at a coincident

point (N1) in space, and co-locating of the second light source and the first imaging means at another coincident point (N2) in space; and,

processing the respective images to reconstruct the leading edge of the object, co-location of the first light source and the second imaging means and co-location of the second light source and the first imaging means producing corresponding angles of incidence and reflection in light transmitted by the respective light sources and received by their associated imaging means, and substantially identical regions of mutual illumination and observation, thereby to eliminate bias and minimize errors in the processing of the images of the object and the reconstruction of the leading edge of the object.